PUERTO RICO AND VIRGIN ISLANDS PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 42* and *Technical Paper No. 53*

Seventeenth Progress Report
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Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
U.S. National Weather Service
National Oceanic and Atmospheric Administration
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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk

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1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development, U.S. National Weather Service is updating its precipitation frequency estimates for Puerto Rico and the Virgin Islands. Current precipitation frequency estimates for the area are contained in *Technical Paper No. 42* "Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands" (U.S. Weather Bureau, 1961) and *Technical Paper No. 53* "Two- to ten-day rainfall for return periods of 2 to 100 years in Puerto Rico and Virgin Islands" (Miller, 1965). The new project includes collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project will determine annual precipitation frequencies for durations from 5 minutes to 60 days, for return periods from 2 to 1,000 years. The project will review and process all available rainfall data for the Puerto Rico and Virgin Island project area and use accepted statistical methods. The project results will be published as a Volume of NOAA Atlas 14 on the internet using web pages with the additional ability to download digital files.

The project area covers Puerto Rico and the U.S. Virgin Islands of St. Thomas, St. John and St. Croix. The project area is currently divided into 7 homogeneous climatic regions for analysis (Figure 1).

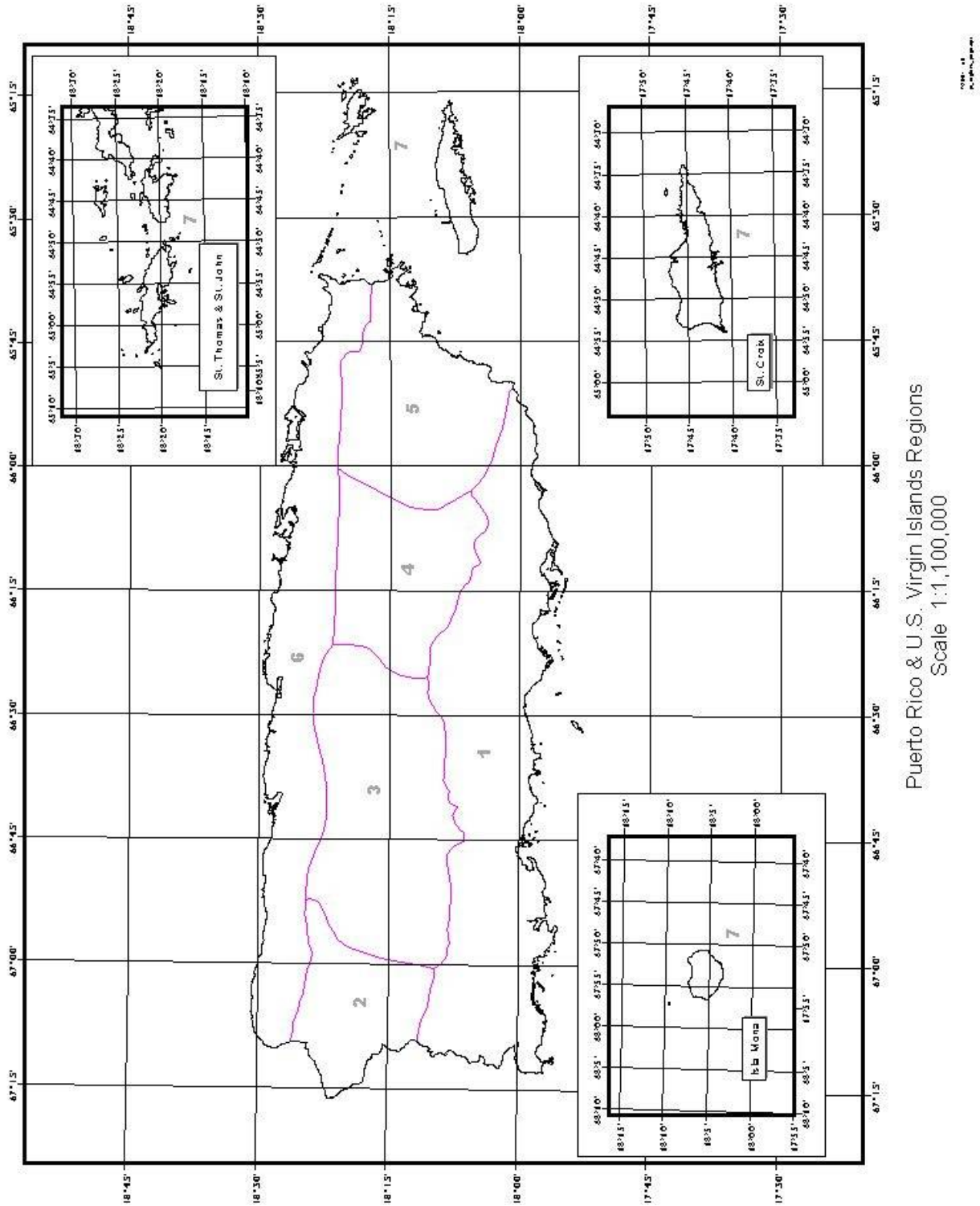


Figure 1. Puerto Rico Precipitation Frequency project area and region boundaries.

2. Highlights

The quality control of extreme values above given thresholds is complete for the daily and hourly datasets. Quality control has begun on the 15-minute datasets from the National Climatic Data Center (NCDC) and the United States Geological Survey (USGS). Additional information is provided in Section 3.1, Data Collection and Quality Control.

A contract was established with the Spatial Climate Analysis Service (SCAS) at Oregon State University to conduct the spatial interpolation of the mean annual maximum values using PRISM. Mean annual precipitation maps serve as the basis for spatially interpolating HDSC-calculated mean annual maximum values. The relationship between mean annual precipitation and mean annual maximum precipitation was tested for Puerto Rico and it proved to be sufficiently strong. Additional information is provided in Section 3.2, Spatial Interpolation.

On September 27th, 2004, HDSC published documentation for NOAA Atlas 14 Volume 1 precipitation frequency estimates for the Semiarid Southwestern United States (Bonnin et al., 2004). It is available at http://hdsc.nws.noaa.gov/hdsc/. Documentation for the Puerto Rico Project will be similar.

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - under went several subtle, but important changes. Additional information is provided in Section 3.3, PFDS.

Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software is 90% complete. An additional study area (Santa Barbara County, CA) has been added and two other study areas (Ventura County, CA and Chickasha, OK) are being considered. There are currently 12 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis. Additional information is provided in Section 3.4, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Collection and Quality Control

The quality control of extreme values above given thresholds is complete for the daily and hourly datasets. Daily values above 4 inches were checked against nearby stations, original records and other climatological bulletins. Three remaining questionable daily values sent to the Service Hydrologist in San Juan were returned and corrected. Hourly values above 1.5 inches were also checked and corrected when appropriate.

Quality control has begun on the updated 15-minute datasets from the National Climatic Data Center (NCDC) and the United States Geological Survey (USGS). 15-minute events greater than a threshold of 0.50 inches are being checked. The quality control of the 15-minute dataset is about 10% complete.

As a reminder, quality control is an on-going process throughout the project. After these initial threshold checks, the next steps involve checking for gaps in records and merging data records at appropriate stations that meet certain criteria. Quality control then continues through the examination of certain statistical measures during the L-moment analysis, such as discordancy. Discordancy represents the degree of “agreement” of the statistical characteristics of one station relative to the stations within its region. Sometimes high discordancy can indicate data quality issues.

3.2 Spatial Interpolation

A contract was established with the Spatial Climate Analysis Service (SCAS) at Oregon State University to conduct the spatial interpolation of the mean annual maximum values using PRISM (Parameter-elevation Regressions on Independent Slopes Model), a hybrid statistical-geographic approach to mapping climate data. Table 1 lists the spatially interpolated grids of mean annual maximums that will be produced through PRISM. These grids will provide the basis for deriving the precipitation frequency grids, therefore they have paramount importance.

Duration
60-minute
120-minute
3-hour
6-hour
12-hour
24-hour
48-hour
4-day
7-day
10-day
20-day
30-day
45-day
60-day
14 grids total

Table 1: Mean annual maximum grids to be interpolated by PRISM.

Mean annual precipitation maps served as the basis for spatially interpolating HDSC-calculated mean annual maximum values in previous precipitation frequency projects (Semiarid Southwest U.S. and Ohio River Basin and Surrounding States). See Section 4.8, Spatial Interpolation, of NOAA Atlas 14 Volume 1 (Bonnin et al., 2004) at http://hdsc.nws.noaa.gov/hdsc/pfds/docs/NA14Vol1_4spatial.pdf. The relationship between mean annual precipitation and mean annual maximum precipitation was tested for Puerto Rico. It proved to be sufficiently strong to produce accurate and reliable grids of mean annual maximum precipitation. The tests were conducted using 60-minute and 24-hour data in central and south-central Puerto Rico. More robust investigation of the relationship will commence once the HDSC-calculated mean annual maximum values are finalized and SCAS begins processing the data with PRISM.

Mean annual precipitation maps have been available for Puerto Rico through SCAS and they recently completed preliminary mapping of mean annual (and monthly) precipitation in the U.S. Virgin Islands. SCAS is conducting a review of the mean and monthly maps. They will make the mean annual precipitation grids available soon.

3.3 PFDS

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - under went several subtle, but important changes that will also be functional for the Puerto Rico project. They include:

1. Several frequently asked questions were added to the FAQ page (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_faq.html)
2. The text on the Seasonality graph axis was changed to be consistent in terminology

3. Updated README file that resides in each of the state- and region-specific anonymous ftp directories
4. Redesigned version table on "GIS Data and Maps" page (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html) making it clearer which version number is associated with which project
5. Updated NA14 documents web page with table and links to the various pdf files representing the difference sections of the draft NOAA Atlas 2 Volume 1 documentation
6. Added Time Series button to state-specific pages
7. Modified state-specific pages without updated data to include links to newly posted scanned documents available via the Current PF Publications page (http://www.nws.noaa.gov/ohd/hdsc/currentpf.htm)
8. 5-year and 10-year exceedances were added to the seasonality graphs

HDSC continuously monitors the hits, integrity and performance of the PFDS, which receives an increasing number of hits per month. The graph (Figure 2) below summarizes the number of individual data inquires made on both the Semiarid Project results and the Ohio Project results, which officially came on-line on June 29th, 2004. The included map (Figure 3) indicates the locations of inquires during the past quarter.

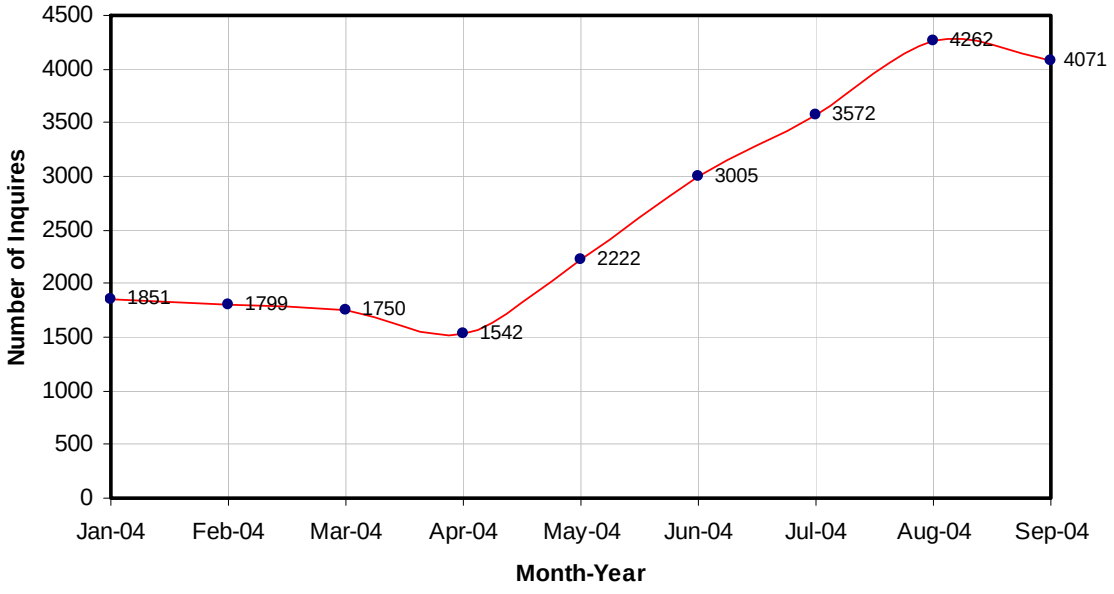


Figure 2: Number of individual PFDS data inquires per month.

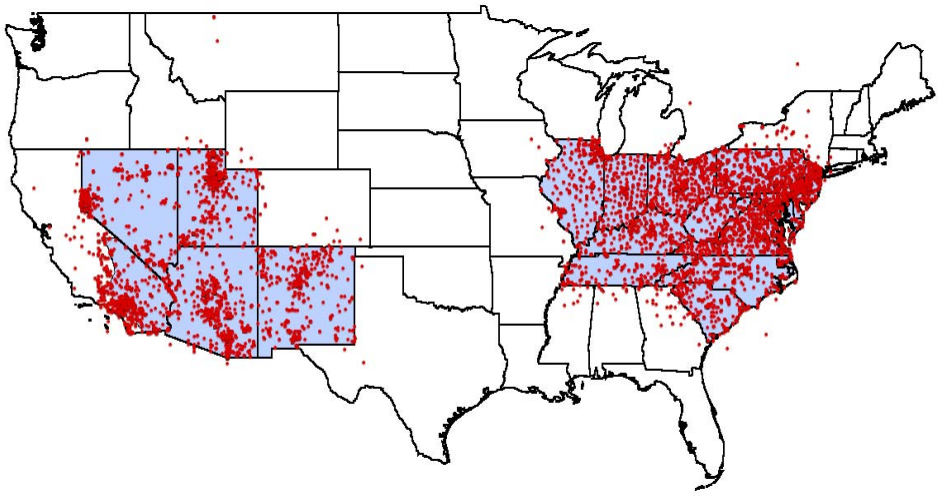


Figure 3: Map of 11,905 PFDS data inquiry locations during the period July-September 2004.

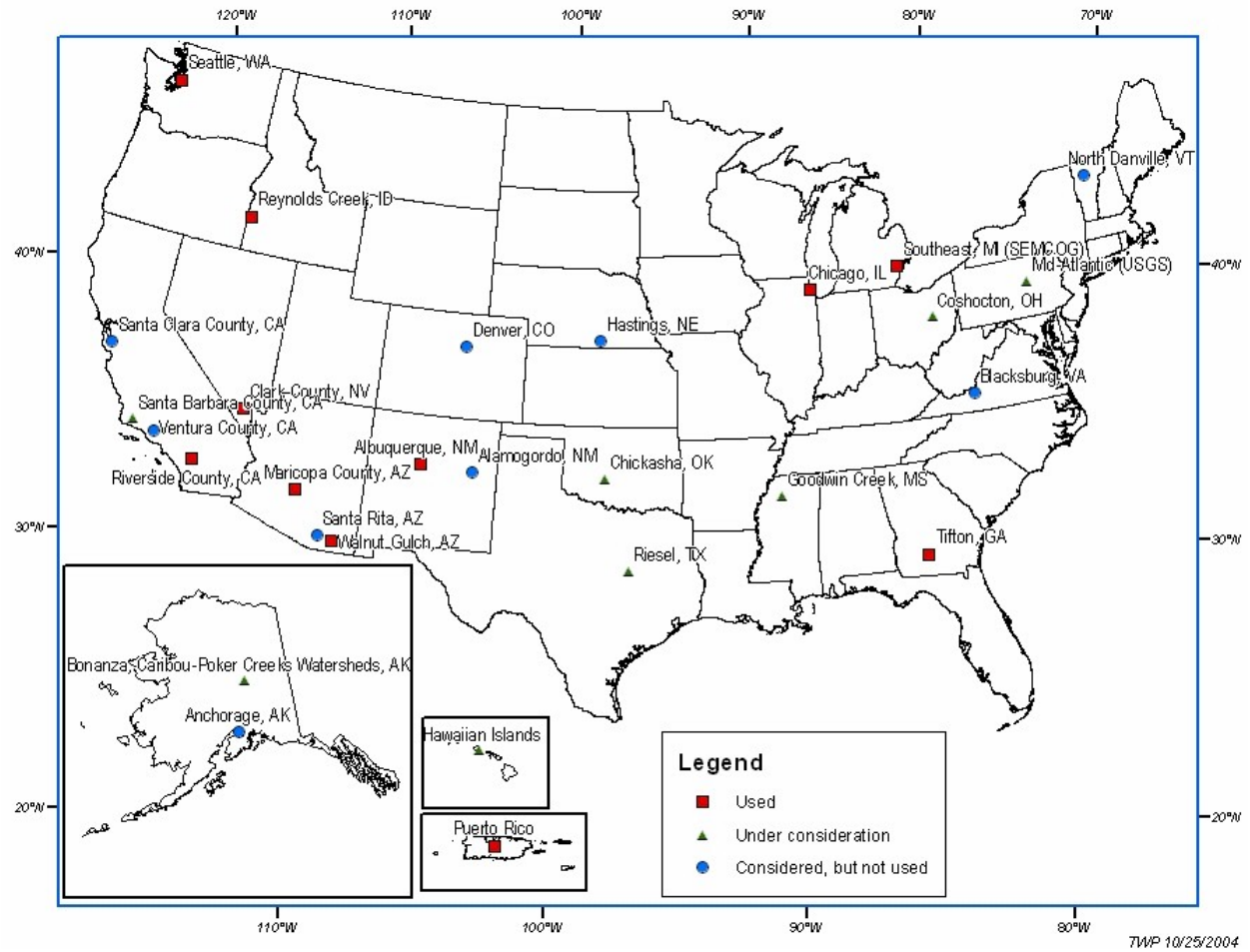
3.4 Areal Reduction Factors

Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software from the procedure described in NOAA Technical Report NWS 24 continues and is 90% completed.

An additional study area (Santa Barbara County, CA) has been added to the list of areas that could be used to develop the final set of ARF curves. Quality control is being performed and will be completed shortly on the precipitation data from this site. Two other study areas (Ventura County, CA and Chickasha, OK) are also being considered. The Blacksburg, VA study area has been eliminated as one of the sites to be analyzed because it lacks sufficient station density.

There are currently 12 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis (see Figure 4). The “not used” study areas indicated in Figure 5 were considered but judged inadequate for the study due to poor data, limited or no metadata, or other problems. The set of ARF curves developed for each study area used will be tested for differences to determine if a single set of ARF curves can be used for the entire U.S. as is the case today or whether separate curves for different regions of the country are more appropriate.

Figure 4: Map of ARF study areas



4. Issues

4.1 Recent and Upcoming Presentations

Past and future presentations by HDSC, include the following:

- "Recent Updates to NOAA/NWS Rainfall Frequency Atlases" at the California Extreme Precipitation Symposium in Davis, CA on July 1, 2004
- An update of the Ohio River Basin and Surrounding States Precipitation Frequency Project progress at the 84th Meeting of the Ohio River Basin Commission on July 14, 2004
- "Recent Updates to NOAA/NWS Rainfall Frequency Atlases" at the Colorado Association of Stormwater and Floodplain Managers (CASFM) Annual Conference in Glenwood Springs, Colorado on September 23-24, 2004

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks to be worked on are also included in this section.

Data Collection and Quality Control [November 2004]
Trend Analysis [December 2004]
Temporal Distributions of Extreme Rainfall [December 2004]
L-Moment Analysis/Frequency Distribution [January 2005]
Peer Review of Spatially Interpolated Point Estimates [March 2005]
Spatial Interpolation of Grids [April 2005]
Precipitation Frequency Maps [May 2005]
Web Publication [April 2005]
Spatial Relations (Areal Reduction Factors) [January 2005]

5.1 Data Collection and Quality Control

During the next quarter, quality control of the updated 15-minute datasets will be completed. Stations will be checked for gaps in the data and some stations may be merged if the criteria are met. Longer durations will be extracted and quality controlled.

5.2 L-Moment Analysis/Frequency Distribution

A comprehensive L-moment statistical analysis will begin on all durations and regions will be reassessed.

5.3 Trend Analysis and Temporal Distributions

Once the data have been quality controlled, an analysis for trends in the annual maximum time series and an analysis of the hourly temporal distributions of heavy rainfall can begin.

5.4 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 12 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

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